Test & Evaluation within the Acquisition Life Cycle

This lesson provides a basic introduction to test and evaluation. It describes the test-related elements and test data requirements within each stage of the acquisition process.

Objectives

1. Given the DoD system acquisition process, you should be able to identify the test and evaluation elements of the acquisition process.
2. Recognize the typical test and evaluation activities utilized throughout each stage of the acquisition process.

What is T&E?

Fundamentally, the purpose of test and evaluation (T&E) in a defense system's development and acquisition program is to help reduce or manage the risks in developing, acquiring, and using a system. This is done, primarily, by providing information to decision-makers regarding:

- risk areas and risk mitigation approaches,
- empirical data to validate models and simulations,
- an assessment of the attainment of system maturity, technical performance specifications and ultimately,
- whether or not systems are operationally effective, suitable, and survivable for intended use.

Why do we do T&E? T&E activities are mandated in several ways:

- Department of Defense Directives,
- T&E Policy, and
- Public Law Requirements.

Managing an acquisition program is a complex job. It can be a real challenge to keep control of the process, making sure that it stays within budget and on schedule. The Department of Defense uses two acquisition processes that consist of development phases ending with milestones that evaluate progress at specific intervals.

T&E Products - T&E is both structured and iterative.

- It follows an orderly and logical sequence of steps.
- It is repeated as the system evolves from models and components to production articles and complete systems.

T&E personnel exercise a system to see how it responds, then document and analyze the results. The product of these efforts is information. This information enables the program manager to determine appropriate actions to reduce risk. The test process

provides the information essential to mitigating risk, including data to verify and validate system models and simulations.

T&E in the Acquisition Process

Program managers have to ensure that the development program produces a quality product that meets the stated performance requirements. That's where T&E comes in. T&E is an integral and critical part of the acquisition process.

Testers provide objective information on the real-world performance of the system, and verify whether the system meets the critical performance specifications that enable it to fulfill the mission objectives.

An acquisition program has different phases and milestones where a system progresses from a mission need to a fielded system. Testing is an integral part of each phase and milestone. This progression from initial concept to fielded system is a long and complex process, requiring substantial monitoring, review and testing. Test and Evaluation activities occur throughout this development process, supporting the decision making process by providing feedback on system design and real-life system performance.

Pre-Systems Acquisition

Once a deficiency is identified, an Initial Capabilities Document (ICD) is developed that describes the need. The mission requirements and system concepts will broadly address the general performance requirements at this point in the process. These mission requirements become more precisely defined throughout the requirements generation process to become mission-specific requirements. Once these requirements are defined, they drive the initial design specifications of the system.

These requirements will continue to evolve throughout the life of the system in response to system development limitations and constantly evolving threats. What is important to testers, is that the initial requirements provide a starting point for determining some of the test criteria that the test and evaluation personnel must address.

Concept & Technology

At this point in the acquisition process, there is only a valid mission requirement. The need is typically expressed as a war fighting deficiency created by a new threat, or a technological development that presents an opportunity to enhance US military capabilities in a specific area.

Milestone A - Concept & Technology Development Concept Studies and Approval in the old 5000, marks the approval to investigate concepts to address the mission need as described by the validated Mission Need Statement.

The Concept & Technology Development phase is essentially a scopeing-down process in which the various proposed system concepts are evaluated and the system concepts with the most promise and the most reasonable amount of risk are identified.
The documents usually produced as a result of this process are:

- **Analysis of Alternatives (AoA)** - The results of initial analyses are presented in the AoA document, which analyzes several system concepts to address a mission need.
- **Capabilities Development Document (CDD)** - Specific system concepts are selected for further analysis. The CDD is developed to help develop the individual system requirements during MS B.
- **Capabilities Production Document (CPD) -** Specific system capabilities are finalized for production. The CPD is developed to document specific system capabilities during production at MS C.
- **Evaluation Strategy, and initial Test and Evaluation Master Plan (TEMP)** - Using the validated ICD, an evaluation strategy for the system concepts is developed and approved 180 days after Milestone A.

Pre-Systems Acquisition - Test Concerns

The Milestone A approval indicates the decision to proceed with the Concept Exploration phase of the acquisition process. This is the same as Milestone A and the Concept & Technology Development phase in the new acquisition process.

At Milestone 0 or A, the exit criteria for the concept phases are also determined. The exit criteria describes what items must be successfully addressed by the system at the end of the next phase of development, such as capability demonstrations or analysis showing the ability of each system concept to fulfill the identified mission need. Successful completion of the exit criteria is required for continuing approval of the acquisition program.

At this point in the acquisition process no actual system testing occurs, however, test personnel are often brought into the process to assist in evaluating proposed system concepts. For example, test personnel may perform modeling and simulation to provide data for the decision makers to assist in their evaluation of system concepts. Testers will also examine the "testability" of effectiveness criteria or evolving system requirements. New technologies will also be initially evaluated at this point. Finally, T&E personnel will assist in developing the first TEMP, in support of Milestone B.

Systems Acquisition

The Systems Acquisition phase is marked by the creation of a program office to manage the acquisition effort. This phase consists of System Development & Demonstration efforts as well as the Production & Deployment efforts. The main emphasis is on maturing the system design and manufacturing processes, and then producing and deploying the system to satisfy the users needs.

Systems Acquisition - Milestone B

At Milestone I or B, a new acquisition program is formally started. The AoA and CDD documents are evaluated by decision-makers, who then compare concepts to determine which approach will satisfy the overall mission need at an acceptable cost. The decision-makers are specifically concerned with evaluating issues such as:

- risk areas,
- performance sensitivities,
- cost drivers, and
- interoperability with existing systems and simulations.

Specific system concepts are then selected for development and a new acquisition program is authorized. In fact, Milestone I marks the actual beginning of an Acquisition program. Exit criteria indicating the successful completion of the next stage of the development process are identified at this milestone.

Test personnel will be tasked to determine the testability of these criteria and develop processes for measuring them. Remember that the successful testing of each of the exit criteria is an essential element in the decision to continue on to subsequent acquisition phases. So test personnel will need to determine measurable criteria based on the approved system requirements and begin to determine testing procedures and any modeling and simulation required to provide appropriate test outputs. These efforts are documented in the Test and Evaluation Master Plan (TEMP).

System Development & Demonstration

During the System Development & Demonstration, or Program Definition and Risk Reduction (PDRR) phase, system developers determine appropriate technologies to use in final system design. The purpose of this phase of development is to determine whether it is possible to develop a suitable system that meets the specified requirements. A primary objective of this phase is to reduce risk associated with technical performance and other risk areas. Designers evaluate individual components to determine feasibility and amount of risk.

Development activities include engineering design and analysis, laboratory and field testing of system components, some modeling and simulation to simulate more difficult areas of system operation, and creation of technology demonstrators to test system concepts.

At this point in the system development process, the emphasis of T&E is primarily on lab tests instead of field tests, on testing of system components instead of complete systems, and on modeling and simulation. Early operational assessments of a system's potential effectiveness and suitability are also conducted, along with verification, validation and accreditation of models and simulations. Testers also review proposed system specifications and evaluate system operational requirements for testability.

Milestone B

Milestone B - Approval for System Development & Demonstration marks the decision to continue with developing a system into a producible design. At this point in the development process, the decision-makers have determined that the system design and development plan have a reasonable chance of success. The exit criteria for MDR 2 are identified at this milestone, which will demonstrate system maturity and readiness for production.

The results of PDRR testing are a major factor in the Milestone B decision to continue with system development.

Testers confirm that the performance of the system components satisfy the previously-determined exit criteria.

Performance factors are not the only criteria utilized by the decision-makers when selecting systems for development. Other factors that are considered include:

- political issues,
- strategic issues,
- budget and schedule,
- changes in the threat,
- the speed at which the system can be developed,
- overall Department of Defense budget considerations, and
- specific system affordability issues.

Milestone C

Once the manufacturing systems and processes are in place ,the system may undergo Low Rate Initial Production (LRIP). LRIP allows the manufacturing processes to be refined through the manufacturing of small amounts of the actual product, ensures that the manufacturing processes are in place once the decision is made to proceed with full rate production, and provides production representative test assets for Operational Test and Evaluation. Milestone C authorizes LRIP in the new acquisition process.
This phase of the acquisition process requires the most intense test effort for testers as they:

- Conduct testing of models and prototypes and full scale articles.
- Produce test data to help refine design and manufacturing processes.
- Evaluate engineering development models and prototypes, hardware components, and production processes.
- Conduct operational testing using production representative systems.
- Conduct Live Fire testing when necessary.

Production Approval

Production Approval indicates that the system is sufficiently mature to begin full rate production or deployment. The program manager is authorized to proceed with full rate production. In the new acquisition process, the Full Rate Production Decision Review provides the authorization to proceed with full rate production and deployment. In the old acquisition process, this was Milestone III.

Test and Evaluation data from the previous phase is critical to the decision to proceed with manufacturing and deployment. The decision-maker utilizes the T&E data to determine whether the design is mature and producible, and whether the system is operationally effective, suitable, and survivable.

Production & Fielding/Deployment

During Production & Fielding/Deployment, full rate production of the system begins. The production items are delivered to the appropriate units for operational employment. These fielded systems require operational support facilities, equipment, and personnel. In addition, the incorporation of new systems will prompt the development of new tactics from EMD, and the training of personnel.

The testing of the system will continue during fielding or deployment. Typical tests during this phase would be verification of deficiency correction from EMD, development and operational tests of upgrades, and production acceptance tests. Some testing may also be required for evaluation of performance and support parameters for post-deployment performance reviews.

Sustainment: Operations & Support

The new acquisition process breaks the Production & Fielding/Deployment and Operations Support phase into two parts. The first part covers the production and fielding/deployment of the systems, and is part of the Systems Acquisition - Production & Deployment phase of the new process. Typical testing during this part would be verification of EMD or System Demonstration deficiency corrections, acceptance testing of production units, and development of tactics for system use.

The second part covers the perpetual evaluation of system performance throughout its life. This is the part that is called Sustainment: Operations and Support in the new process. Typical test activities during this part would be follow-on operational testing by the user, operational tests of upgrades, and further tactics refinement.

Demilitarization & Disposal

The life span of a system can vary from a few years to decades. Many systems have also had their operational life spans dramatically extended over the original plan and estimates. For example, continuing updates to the B-52 bomber have kept it flying for decades longer than planned.

When systems are taken out of service, environmental issues can complicate the disposal of the system. Hazardous waste concerns can require expensive disposal procedures. Recycling objectives can also complicate disposal.

Although there is limited capability for a tester to actually test or evaluate a system's capability to be demilitarized or disposed of at the end of its life cycle, test personnel should try to consider these life cycle issues when evaluating plans for system design, development, and operation.

Test Activities Throughout the ALC

Test activities occur throughout the acquisition process, as you have already learned.

- **EOA** - Early Operational Assessments are conducted during the initial stages of development to provide preliminary user insights and perspectives prior to making the Milestone II decision to proceed with engineering and manufacturing development (EMD). These initial assessments help identify potential operational-related problem areas.
- **DT&E** - In the early stages of the process, Developmental Test and Evaluation is used to evaluate system components, concept prototypes, and technology-related risk areas.
- **OT&E** - Later in the engineering and manufacturing development phase, Operational Test and Evaluation activities receive more emphasis.
- **EOA, DT&E and OT&E** - The data generated by these test activities are utilized by the decision-makers when evaluating the status of the program at each of the process milestones, most especially at Milestone III where data becomes an essential element of the decision to continue with production of a system.

Decision-Making Support Systems

As you learned in the earlier in the course, the decisions that guide the system acquisition process of which you have just learned, originate from the interactions between the three decision-making systems.

1. **Planning, Programming & Budgeting** - This is where the programs are funded.
2. **Requirements Generation** - This is where the appropriate documents are generated in order to identify the user's needs.
3. **Acquisition Management** - This basically is the testing function and the management of the overall acquisition program.

There must be an effective balance between all three of these areas to successfully develop and deliver a system that meets the needs of the user. The intersection of each signifies T&E activities.

The effect of the interaction of each of these areas of concern can be complex and frustrating when trying to accomplish competing objectives. T&E activities become essential components of each of these areas by providing an objective method of evaluating the status of the ongoing program. Test results impact the project funding and budget, confirm the successful completion of program milestones, and provide a direct correlation with the ability of the system to address a mission need.

Review Questions

1. Given the DoD system acquisition process, you should be able to identify the test and evaluation elements of the acquisition process. (Answer)
2. Recognize the typical test and evaluation activities utilized throughout each stage of the acquisition process. (Answer)